DOCUMENT RESUME

ED 280 336 HE 020 151

AUTHOR Bergsma, Harold M.
TITLE Technology Transfer through Training: Emerging Roles for the University.
PUB DATE Jan 86
NOTE 18p.; Paper presented at the Regional Conference on University Teaching (2nd, Las Cruces, NM, Janaury 8-10, 1986). For complete proceedings, see ED 276 328.
PUB TYPE Viewpoints (120)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Change Agents; *College Role; Curriculum Development; *Developed Nations; *Developing Nations; Economic Development; Higher Education; Technical Assistance; *Technical Education; *Technology Transfer; Trainers; *Training Methods

ABSTRACT

The importance of training in the technology transfer process is discussed, with special consideration to conditions in developing countries. Also considered is the role universities can play in training to promote technology transfer. Advisors on training and curriculum development are needed to introduce a new technology. Training farmers to improve irrigation in Pakistan involves teaching those who train the farmers to systematically select what will be taught and appropriate techniques for training. U.S. universities are increasingly being requested to participate in the technology transfer process abroad. For technical educators at universities, a great challenge exists to become involved with foreign technologists and scientists in designing curriculum and training systems that will optimize the way people learn and adapt to new ways of living. An outline is provided of a technical training systems model that covers purpose, formulating learning tasks, quality control, and design training system. Difficulties experienced in introducing technologies in poor countries are discussed. (SW)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED280336

TECHNOLOGY TRANSFER THROUGH TRAINING: EMERGING ROLES FOR THE UNIVERSITY

by

Harold M. Bergsma, Ph.D.
New Mexico State University

HE020151

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Harold M. Bergsma
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

In the early sixties much was written about the problems of introducing a technology from one country into a second country. Everett M. Rogers, in his now well-known book (reprinted many times since the sixties), Diffusion of Innovations (Rogers, 1983), defined technology as "a design for instrumental action that reduces uncertainty in cause-effect relationships involved in achieving a desired outcome". He states that technological innovation creates uncertainty in the minds of potential adopters particularly in regard to the expected consequences of adoption. The process of making decisions for adoption of both the hardware and software of a technology is a delicate one -- because the bringer of innovation, introducing for instance an improved model of an irrigation ditch, must understand the problem of the adopter-user and must try to reduce the new user's uncertainty, and enhance his knowledge of the advantage of this technology. This, according to Rogers, will require careful communication of two types of information in respect to a technology such as the cement-lined irrigation ditch. First, there is information about the software of the technology, that is knowledge from research, etc. embedded in the technology itself and inherent in its production and use, which relates to the cause and effect relatioship leading to desired outcomes. Second, there is information about the innovation/evolution information which is the "reaction of uncertainty about an innovation's expected consequences".[1] Bringers of change in the past twenty years have become sensitized to these concepts

relating to technology transfer and have adopted more effecttive means to introduce new artifacts, new ideas, or, new technologies. Communications have been enhanced to the extent that conferences are held to highlight how progress in various develop- ment programs have been achieved; the Second International Conference, Desert Development is a case in point. Meetings are also held within projects which bring the adopters of innovation face to face with those who are introducing new technologies to improve the ways adoption can occur and avoiding pit-falls and past mistakes.

More specifically, the level of sophistication which has been achieved in technology transfer has increased tremendously in the last ten years. There is, however, an area of concern that requires additional work in all technical projects, and this concern is training. First, training needs to be given a greater priority in the development of project papers and in the design of technical projects.[2] Second, the technologies of training and curriculum development, which have in the past ten years become more sophisticated, need to be adopted in training programs of the technical project of universities, the seats of education and research in the world today. Colleges of educational technology within these institutions can play an important role in future years to bridge a gap that exists in providing expertise related to training technology.

Assume that a developing country or an area of development within a country, has been approached with a new technology and

has been sold on the need for both the ideas and the hardware of the innovation. The first stages of the communication process for adaptation of a technology, to use Roger's ideas, have been met. Both parties are desirous of the innovation and plans for change are established. Precisely here is where the gap occurs. Users of the technology, such as farmers, businessmen, bankers, and even auditors, are not able to utilize the technology used because they lack know-how and lack the basic education that training could provide. Training is the prime means to bring about user knowledge and user adaptation of a technology.

The writer recently worked with the national Pakistan Audit Department to provide training to future trainers, the auditors who would work with their staffs to introduce "software" innovations such as micro-fiche record keeping. What was being attempted was to provide prospective auditor-trainers knowledge about new auditing technologies in a framework in which new knowledge about the technology of training was explored and practiced. These auditors learned about how adult students learn, how to motivate adults, how to structure basic information into a curriculum in order to simplify the tasks of teachers and clarify the roles and mission of the Auditing Training Institute.

Another example which comes to mind relates to the development of the On-Farm Water Management in Pakistan. The writer worked for the Pakistan government as an advisor on training and

curriculum development. Irrigation engineers, agronomists, and sociologists, were concerned with how to improve irrigation structures so that much precious water would not be wasted by farmers. Beautiful structures were carefully engineered and built. Agronomists researched how best to increase crop yields by optimal water application techniques. Sociologists studied the problems of how to best establish "Water User Associations" among disparate social and economic groups. But there was a gap. Water users and farmers continued to use water in much the same way as they had before. (Some water is good, more water is better.) The problem (the gap) related to the need to teach farmers to learn new ways of using the ditches, i.e. the hard ware; the softwares of the technology, i.e. scientific application of water, which are the ideas inherent in the technology itself also become the concern for trainers.

In the case above, farmers needed training. However, to achieve this those who train the farmers needed to be trained in appropriate techniques for training and develop a systematic approach to determine what should be taught. Vocational/technical training differs greatly from formal academic training, primarily because there are a limited number of skills or areas of knowledge required of users of new technologies. Various training models are now being used for this purpose. The model in Figure I on the next page has been utilized in a variety of technical training situations internationally and is applicable for use in most areas where training is needed in the technology transfer process.

TECHNICAL TRAINING SYSTEMS MODEL

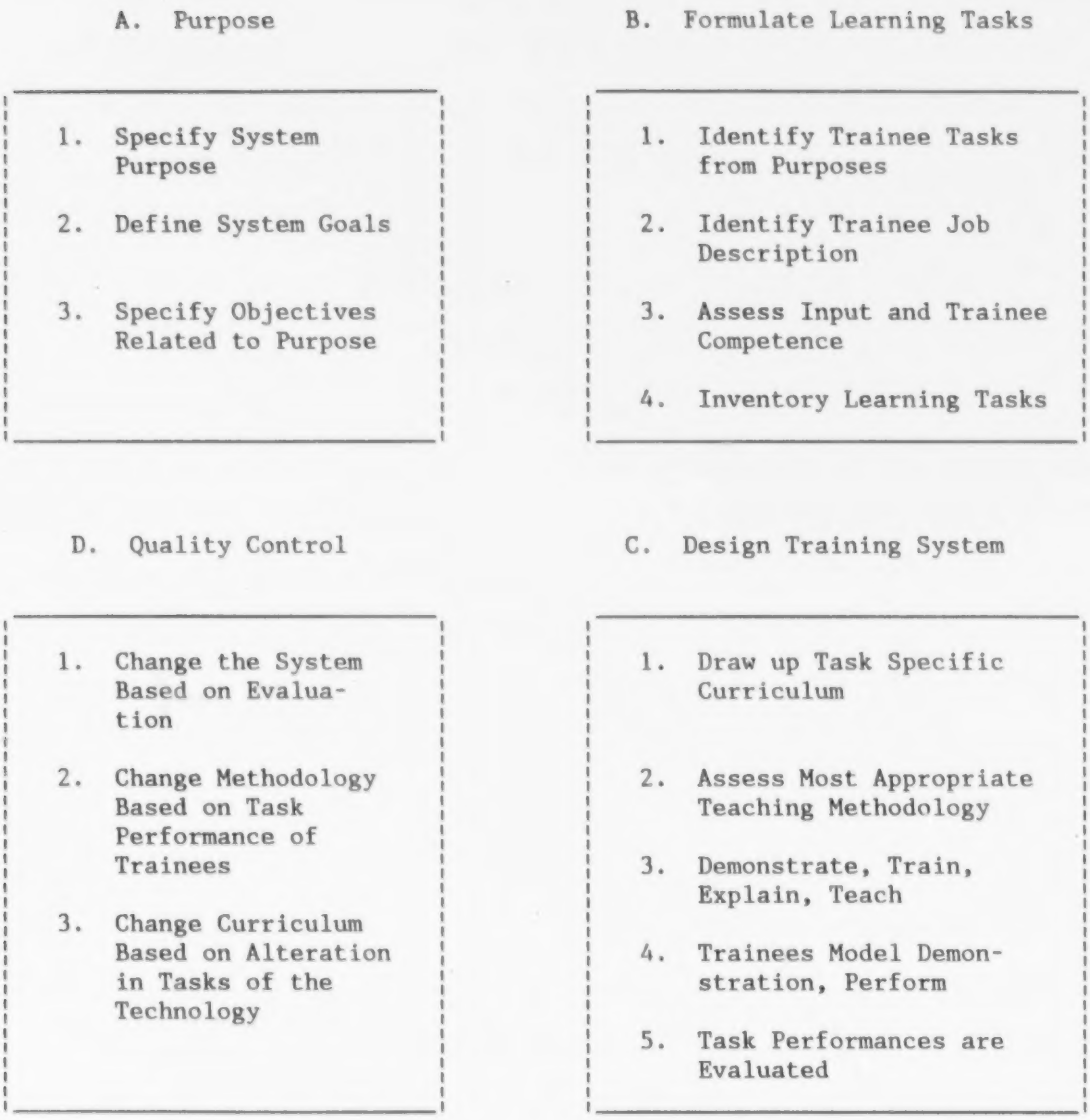
A. Purpose
1. Specify System Purpose
2. Define System Goals
3. Specify Objectives Related to Purpose
B. Formulate Learning Tasks
1. Identify Trainee Tasks from Purposes
2. Identify Trainee Job Description
3. Assess Input and Trainee Competence
4. Inventory Learning Tasks
D. Quality Control
1. Change the System Based on Evaluation
2. Change Methodology Based on Task Performance of Trainees
3. Change Curriculum Based on Alteration in Tasks of the Technology
C. Design Training System
1. Draw up Task Specific Curriculum
2. Assess Most Appropriate Teaching Methodology
3. Demonstrate, Train, Explain, Teach
4. Trainees Model Demonstration, Perform
5. Task Performances are Evaluated

FIGURE I

A great challenge exists for educators to train technicians who introduce innovations by using appropriate methods of packaging information, that is, curriculum development, and in how to motivate the learner-users about the new technology. The focus here is on human resource development.[3] Frequently, dysfunctional development programs were rooted in human learning problems.

Ishtiag Qureshi, once Minister of Education in Pakistan, tells the story of efforts to incorporate training programs into economic development schemes soon after independence, in the early fifties. He tried to persuade an official high in the government bureaucracy to agree to sponsor a plan whereby the Ministry of Education would apply for aid from an American foundation. The reply given to him was, "We should first satisfy the hunger of the poor, luxuries like education will come later." Qureshi reports for Pakistan what was true for many developing countries in the fifties and sixties, in fact in many cases, up to the present.

Economic planners frequently looked on education and training as almost irrelevant in the entire process of economic development. During the past twenty years, particularly in sub-Saharan Africa, development plans did not bear fruit as many had hoped. Predictions for change did not, in many cases, work out as expected. People in the third world frequently accepted the artifacts of technology, but were unable to use and maintain these optimally. Economic growth was tied to political realities

and those elites who were influential in maintaining their own status. Economic development was rooted in its "source of inspiration", to use Qureshi's words, ". . . the manpower to bring about and establish development".[4]

The last twenty years might be characterized as an era of technology transplant, as opposed to an era in human resource development. Communication systems in rich countries advanced rapidly with other technologies. These systems, in their advanced forms, including television, radio, computers, telephones, newspapers and movies were introduced into undeveloped countries rather early in the development process. These became necessities for the elites. Soon the poor countries were bombarded with information about ways of life elsewhere and the living styles of the wealthy. With their own eyes people saw how the rest of the world lived and made comparisons about their own life styles and obvious deprivation. Isolated poverty was tolerable when people had no comparisons and believed that their way of life was normative. Even the idea of others was rather foreign to the isolated village man. But placed side by side, very rich and very poor, prosperity and poverty, a politically dangerous situation emerges. Political change in the third world has been rapid and frequently violent as evidenced in South America and Africa.

The highly complex process of economic change and development was tied to the general standard of living and educational levels of the people. However, these standards and levels were

not evenly spread. In particular, in every developing country the gap between the poor and rich grew wider. In Pakistan this gap was seldom bridged with communications and attempts at social integration between the rich and poor, rather the development process polarized the communities into distinct classes. Rich and poor nations, during the past twenty years have similarly developed gaps. The richer nations, because of highly developed economic structures, have accelerated and developed their supporting technologies based on high levels of literacy and availability of general education for the majority of their people. Poor nations on the other hand, lacking sophisticated infra-structures, were farther behind comparatively. The elites at the top who had received good educations in universities abroad, received not only power, but managed the economies within the political structures in which they worked. Conversely rich countries experienced the development of an affluent middle class who became eager consumers of new inventions. In poor countries the middle class was frequently very small. The masses remained in poverty, living on the land, subsisting, but not able to enjoy the benefits of a middle class which was consumption oriented.

Economic development seen in this framework is certainly a complex process since humans and the resources available to them are a vital aspect of stability and change. Consequently, planners in the eighties are far more cautious and wary of simplistic development solutions, and of being too hasty with

the introduction of technologies which can not be supported by poor countries. Experts working in foreign development settings come with their pockets bulging with technological know-how and equipment to do the job. Their biggest challenge relates to dealing with people, educating and training, so that the very technology they introduce becomes socially functional.

Farmers are now the target for international aid in most developing countries. It is now well understood that any development of an industrial structure must have as its support system, an agricultural structure which can feed the people and raise the standard of living of the population. Strategies toward this end are now being suggested. A recent publication, Promoting Economic Development in Central America, states:

> The broad strategy is: First, to arrest the declines in incomes, employment, and economic activity by means of major balance-of-payments assistance; Second, to lay the foundation for long-term economic growth and the infrastructure necessary for export orientations; Third, to assure the widest possible distribution of the benefits of growth through assistance for improving health, education, and housing for the poorest groups; Fourth, . . . technical training, and the development of leadership skills.[5]

Concomitant with such planning comes development interruptions in the form of huge famines in Africa, frightening refugee problems in Afghanistan, Western Sahara, South and Central

Africa. Africa's growing dependence on foreign aid, along with many other third world countries, creates additional interruptions in the attempts to bring development assistance in a way that recipients can support. John C. Whitehead,[6] Deputy Secretary of State, outlined a proposal which is a coordinated attempt to bring various international donor groups together to help solve the growing world crisis of hunger particularly in Africa. Included in his plans are ways to help people to help themselves, to educate, to train and to provide long-term educational programs, sector-wide in their scope.

Literacy education is a feature of most development plans. Along with development of the agricultural sector to support industrial growth, are efforts made to increase literacy rates. Qureshi's story again comes to mind. It is important to satisfy the "hunger of the people" first, but general development involves an integrated and complex interaction between people and technologies between satisfaction of the hunger for more information and more knowledge and improved health.

Eric Ashbey (1962), the author of the well-known Ashbey Report (1962),[7] was concerned with drawing up a manpower development plan for Nigeria. His writing was infused with the idea that education was the leaven for economic development. Education had to occur simultaneously with economic planning and the introduction of new technologies. Another economic expert at this time was Harbison who argued in the Ashbey Report (1964) that "a plan for economic development must consider available

resources of manpower trained to different needed levels and must make provision for such education and training."[8] Under-developed countries at that time faced a special problem. They had a limited educational base and a limited industrial support system. Training manpower for absorption by the economy was frequently an unpredictable and delicate affair. An over-emphasis in one area could result in imbalance and dysfunctional programs. Formidable expansion of secondary grammar schools and educational facilities was the mood of the Sixties.[9] Most of these schools today, in the eighties, are in shambles.

In highly developed countries the sheer mass of the educational and industrial system insured that adjustment could be made fairly readily to supply manpower to be absorbed by the developing technologies. In less developed countries it was found that there was the danger of over-production of people whose education did not match national needs. Highly trained people who could not be absorbed into a limited industrial/technical sector in the third world became unemployed. In one sense, a person who was a technician but not employable was worse off than a common laborer looking for work.

Forecasting what type of person would be needed to support developing industries became the hazardous job of planners, particularly planners who suggested changes in educational systems. In Pakistan, manpower planning for training occurred very late. Vocational/technical training programs at present in Pakistan are realistically in their infancy. New technical

schools require large capital investments for machinery and equipment. The machinery must be up-to-date and similar to what is used in industries. Funding needed to establish new institutions is simply not available. One need but travel from one technical training school to the next in Pakistan to see how poorly equipped these institutions are. Shops are meagerly equipped and many tools are in disrepair. The record of Pakistani industry in the maintenance of machinery has been very poor. In many instances its main cause has been the lack of training and skill among technicians.[10]

Manpower training requires tools. Lacking tools, training tends to become purely theoretical and non-experimental. Two or three generations of graduates who are trained without learning adequate skills dilute the entire system. Standards go down rapidly. Frequently, one way out is to seek another injection of foreign aid to boost the system for a while.

In many instances training of trainers is not a central aspect of the foreign aid package. Simplistic solutions have not worked. Short-term plans to "put out brush fires", leave the land scorched and arid. For instance, in the process of training technicians it is important to remember that these people have a need to be broadly educated so that they have some understanding of their own society and its needs and a sense of personal responsibility to carry out tasks in functional ways. A narrow vocational training especially in the early phases of development is likely to be unproductive. Philip Foster

discusses this action well in much of his writing. His article, "The Vocational School Fallacy in Development Planning,"[11] reviews what occurred in India. Educators developed technical training programs which put hundreds of children at spinning wheels and looms. Not only did such programs fail to remove the cause of poverty by such training, a feeling of hopelessness was generated among those so trained.

It may be argued that the major concern of most developing countries is not to bring in sophisticated science and industry, rather to raise the standard of living sufficiently so that poverty is reduced and the general standard of living of the masses rises. Economic development in this frame of reference, requires continual attention to the development of training systems in all sectors related directly to the capability of countries to sustain this growth. Development in this sense is evolutionary, gradual and tied to on-going structures which exist in the societies in question. Development requires sustained time to occur.

W. David Hopper defines the development process as one in which "the pile of goods available to a population is increased at a pace much in excess of the traditional rate of growth or output,"[12] He goes on to state that development as he sees it is the "problem of engendering and supporting the transformation of the technological basis of production for . . . people, who were primarily dependent upon traditional agriculture and Agrarian techniques, to methods based on modern science and

technology. This transformation is the core of today's development concern."[13] Planning for training has its genesis here, the development of functional educational systems which allow for learning new ideas and developing knowledge to unleash new technologies. Another way to say this is that investment in human capital, building people, is the arch stone of the development process.

Educational Technologies for Development

An American university professor working as a technical expert for a World Bank project in Pakistan a few years ago, was asked to help provide training to nationals in his area of expertise. His reply was, "Training is not on my terms of reference and is not on my job description. Sorry, I am here as a technical expert, not a trainer." Don Dwyer, the Executive Director of the Consortium for International Development (CID), mentioned in his speech given at New Mexico State University in December of 1985, that our technologies and expertise is assumed when we go abroad. Our major task will be to educate, to teach, and to train people. Universities are dedicated to this mission and therefore universities should have a central role in human resource development.

Institutions of higher education in this country are being requested to participate in the technology transfer process abroad at an ever increasing rate. The expertise within these university systems is vast, impressive and flexible. Through

US-AID, the World Bank and Asian Development Bank, among others, vast development proposals are being planned and funded. These proposals are frequently being staffed by university professionals. A tremendous challenge exists for these agents of change to consider the best possible means to introduce technical systems abroad. For technical educators, professionals in universities, a great professional challenge exists to become involved with foreign technologists and scientists in designing curriculum and training systems which will optimize the way people learn and adapt to new ways of living.

> Just as the primitive technologies of manufacturing and industry have been replaced by scientifically based procedures that provide a high degree of product control,so too is it anticipated by many that a scientifically based technology of education will emerge that will provide a high degree of control over the educational product. . .
>
> The concept of the development of a technology of education is somewhat different from that of providing a scientific basis for guiding the decisions the teacher has to make. A technology would, presumably, establish specific and well-defined procedures through which particular goals could be reached, together with packages of materials through which the goal could be achieved.[14]

Training people for productive work will require the attention of such teams working together to bring about change.

REFERENCES

[1]Rogers, Everett M., (1983). Diffusion of Innovations. New York: The Free Press.

[2]Costly, Dan L., and Todd, Ralph (1978). Human Relations in Organizations. Los Angeles: West Publishing Company.

[3]Sweetnan, Sherry (May, 1986). Training Proposals That Sell Themselves. Training and Development Journal. American Society for Training and Development.

[4]Qureshi, I. (1975). Education in Pakistan. Karachi, Pakistan: Ma Aref, Ltd. p. 218.

[5]McCormick, R. (1985). Prompting development in Central America (Current Policy No. 759). Washington, DC: Department of State, Bureau of Public Affairs.

[6]Whitehead, J. (1985). The African Crisis (Current Policy No. 757). Washington, DC: Department of State, Bureau of Public Affairs.

[7]Ashbey, E. (December, 1962). Mission and challenge of west African universities, Teachers' College Record, 227-230.

[8]Ashbey, E. 1964). African Universities and Western Tradition. Cambridge, Mass: Harvard University Press. p. 227.

[9]Bergsma, H. (1978). Education for International Development: Problems for Planned Change. Dialogue Series, New Mexico State University.

[10]Op.cit., Quershi, p. 222.

[11]Foster, P. (October, 1975). Dilemmas of educational development: What we might learn from the past. Comparative Educational Review, 378-402.

[12]Hopper, D. (1983). New horizons for education in international development. Proceedings of Presidential Symposium: New Horizons for International Development. Consortium for International Development. Arizona. p. 11.

[13]Ibid. p. 12.

[14]Travers, Robert M. W. (1972). Essentials of learning: an overview for students of education (3rd. Ed.). New York: McMillan Company. P. 493.